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PARASITES OF WESTERN AUSTRALIA
IV
OBSERVATIONS ON THE GENUS *MARSUPIOPUS* FAIN, 1968 (ACARINA: ASTIGMATA: GLYCYPHAGIDAE)

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ABSTRACT

A new species found in the tail follicles of *Zyzomys argurus* is described and figured. Tritonymphs and adults have been reared and confirm the systematic position. Pathological reaction of host tissues results in amputation of tail parts.

INTRODUCTION

In a former study Fain & Lukoschus (1976) described three new species and one new subspecies and compared them with the known species of the genus *Marsupiopus* Fain, 1968. The genus was known only from the hypopial stage, parasitic on mammals and restricted to Australia. Systematic arrangement in the family Glycyphagidae Berlese, 1887 is based on morphology of hypopi only. During the Western Australia Field Programme one of us (F.S.L.) was able to collect further specimens, rear hypopi through to adults and observe the pathology in *Zyzomys argurus* (Thomas, 1889). For the first time adults of the subfamily Marsupiopinae Fain, 1968 are described, confirming the systematic arrangement.

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MARSUPIOPUS ZYZOMYS SP. NOV.

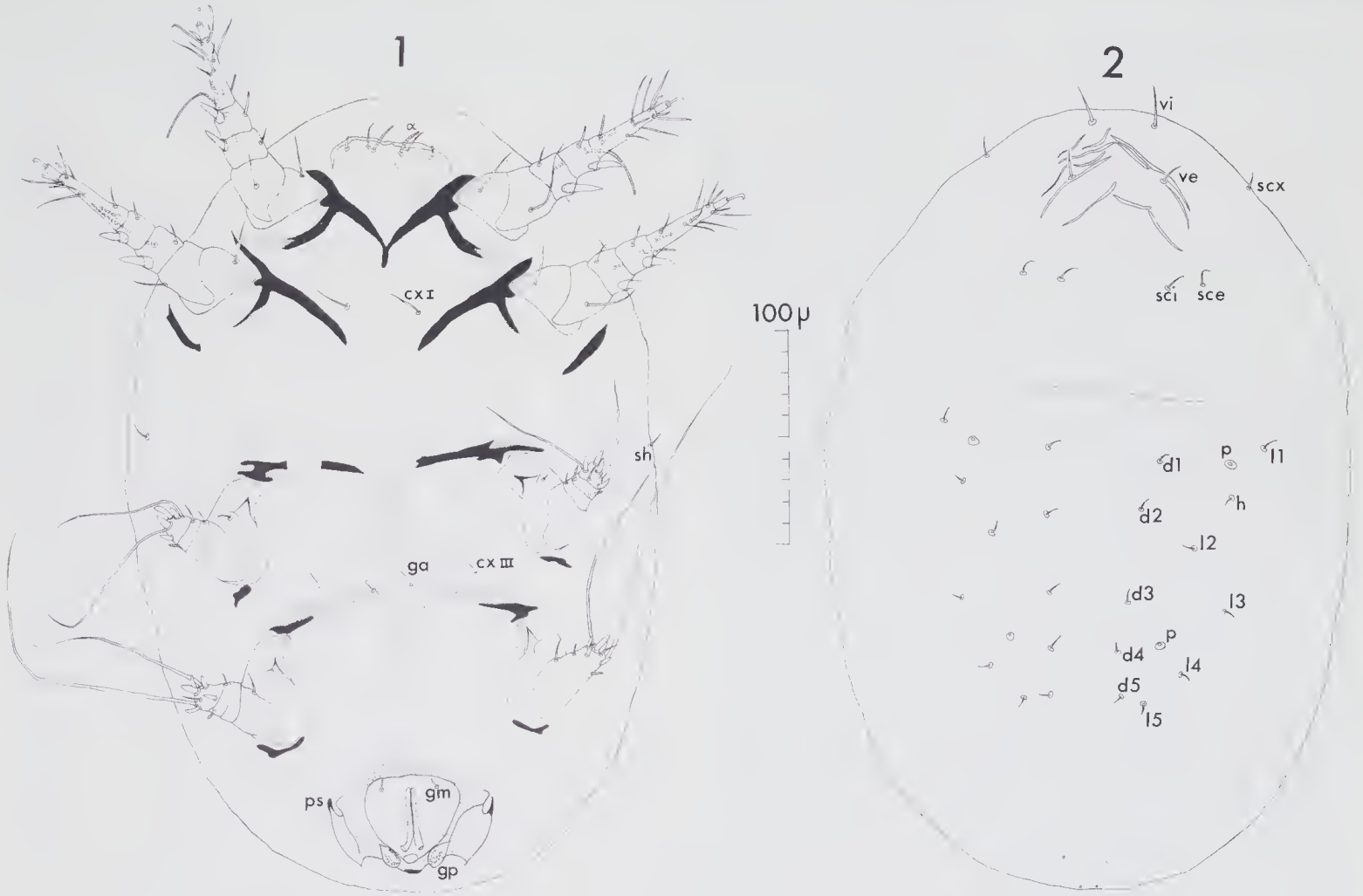
This species is closely related to *M. antechinus* Fain & Lukoschus, 1976. Hypopi differ mainly by indistinct sejugal furrow, longer tarsi I, longer tibia I solenidion and several other measurements, which are given in **Table 1.**

Table 1: Comparison of measurements (in μ) of hypopi of *Marsupiopus antechinus* Fain & Lukoschus, 1976 and *M. zyzomys* sp. nov.

	zyzomys	*antechinus*
cx I, *cx* III	16 10	10 7
g a, g m	10 11	6 6
v i, v e	19 14	15 10
sc i, sc e	10 9	10 11
h, sh, scx	6 9 10	6 7 9
dorsal 1-5	7, 7, 7, 6, 6	7, 11, 12, 9, 7
laterals 1-5	6, 6, 6, 6, 6	8, 8, 8, 9, 10
tarsus I-IV	33, 34, 11, 12	21, 21, 10, 10
pretarsus I, II	10 10	6 6
claw I, II	10 9	8 8
omega 1, 3, II	11 9 11	14 9 12
phi I-IV	40, 25, 7, 5	29, 16, 9, 7
alpha	14	14
alpha-alpha	15	13
palposomal setae internal, external	14 7	16 10
perigenital ring width	77	60
perigenital ring length	52	54

Hypopus (holotype) with unornamented white cuticle of ovoid shape, showing the characteristics of the genus. Length 364 μ, in 10 paratypes measured average 343 μ (306-366); width 242 μ, average in paratypes 217 (193-245).

Venter (Fig. 1): Cuticle white and smooth, legs and epimera yellow-brown. Epimera I fused in short Y-shape, epimera III and IV fused with median pregenital sclerite. Palposoma well marked with solenidia *alpha* and two unequal pairs of setae. Two small rings behind solenidia. Genital region with

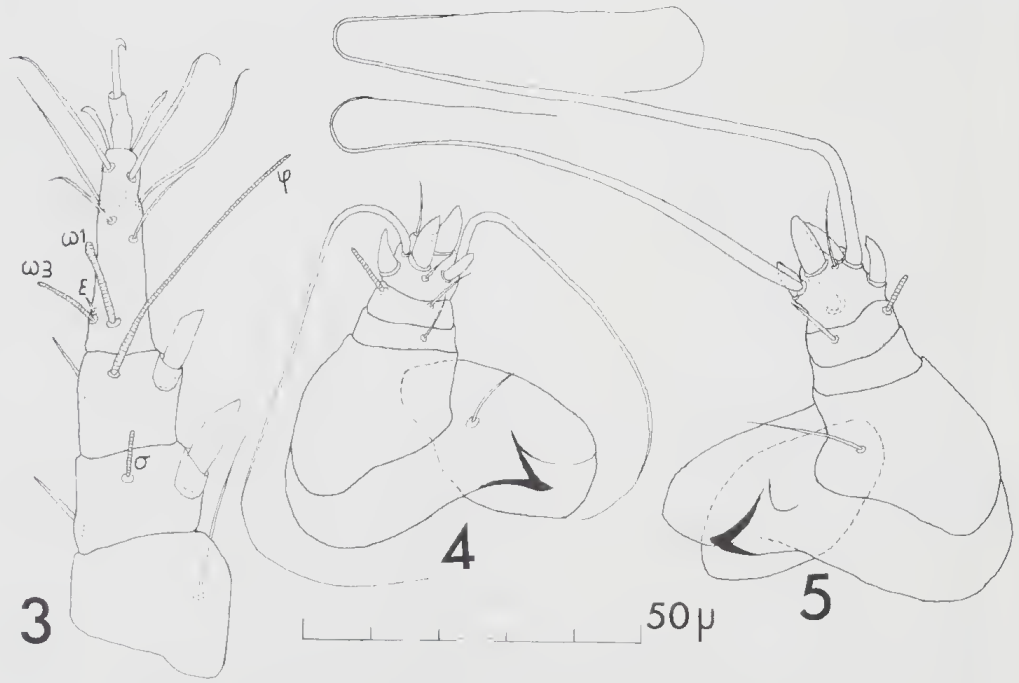


Figs 1-2: *Marsupiopus zyzomys* sp. nov., hypopus, holotype venter (1), dorsum (2).

sclerotized perigenital ring carrying lateral spurs, arising from ventral surface (Fig. 21, *ps*), setiform *g m* and disc-like *g p*, which apparently have adhesive function. Genital suckers (*gs*) two-segmented beneath genital valves (*gv*) in median direction (Fig. 20). Anus (A) distinct and opening into genital atrium. Coxal setae present in fields I and III, genital anterior on epimera IV.

Dorsum (Fig. 2): Cuticle weakly sclerotized with tiny spots in region between laterals 4 and 5. Irregular grooves in propodosomatal region. Sejugal furrow within a transverse region of soft cuticle indistinct, in many paratypes not observable. Present are all idiosomatal setae in short setiform shape. Dorsal gland between *d 3* and *l 4*, pore between *l 1* and *h*.

Legs (Figs 3-5) with five free segments. Legs I and II of strong normal shape with pretarsus and sickle-shaped claw, setiform femoral hair; legs III and IV short, stout, directed forwards, without pretarsus and claw. The spurs on trochanters III and IV and deeply inserted strong spines on tibiae and genua I and II serve together with the lateral spurs of perigenital ring and disc-like *g p* to anchor the hypopus within the hair follicle of host. Chaetotaxy of legs: tarsi 9-9-8-8, tibiae 2-2-1-1, genua 2-2-1-0, femora 1-1-0-1, trochanters 1-1-1-0. Solenidiotaxy: tarsi 2-1-0-0, tibiae 1-1-1-1, genua 1-1-0-0. Famulus present. Shape of setae in figures, measurements in Table 1.



Figs 3-5: *Marsupiopus zyzomys* sp. nov., hypopus, legs I, III, IV.

REARING EXPERIMENTS

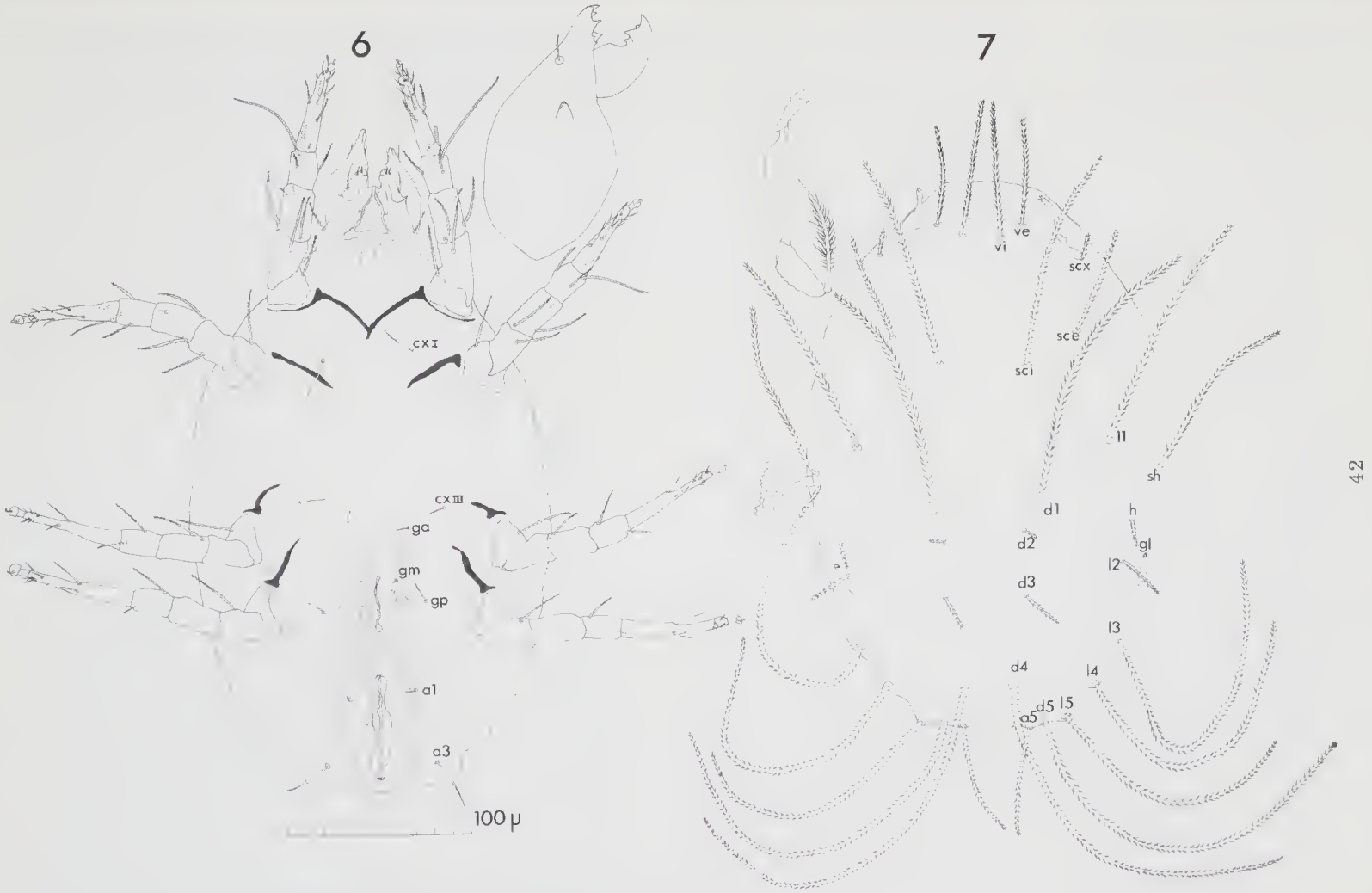
Eleven rearing tests were started between 30 August and 19 September 1976. Hypopi of severely infected female hosts pressed out of hair follicles were placed in 10 ml glass vials together with sebaceous fat and skin scales scraped off from host tail and with parts of tail. The vials tops were covered; some with densely woven cloth material, others with plastic stoppers. To maintain the necessary high humidity, small strips of wet paper were put into the stopper-closed vials, while the cloth-closed vials were placed in cans with about 1 cm of water and the can top almost closed. To get relatively low temperatures, cans were stored in continuously shadowed rock clefts or between the roots of *Pandanus* palms just above the water level of pools. Hypopi samples, taken from hosts trapped alive and killed before storing in an ice-box for one day, gave rise to tritonymphs after three to four days (good results of trapping lines could not be observed immediately, they were preserved in an ice-box for later investigation and skinning). Vials were observed daily and specimens preserved in alcohol after 10 days or when mites were found dead. Tests were done in the middle of the dry season when temperatures were up to 45°C. Death of mites was obviously caused by the high temperatures.

Tritonymph of white to pale yellow colour; ovoid shape with the characteristics of family Glycyphagidae. Total length of figured specimen 369 μ, average 390 μ from 10 paratypes measured (343-432), width 195 μ average in paratypes 230 (193-249).

Venter (Fig. 6): Epimera I fused in V-shape, II-IV free, epimerites absent. Genital region between legs IV with two pairs of 8 μ small normal shaped genital suckers. Anal split 48 μ long with three pairs of anal setae (*a 1*, *a 3*, *a 5*). Gnathosoma with dentated chelicerae, palps with two free segments, which carry two setae and one solenidion, and two pairs of setae on pedipalpal coxae and labrum. Coxal setae in fields I and III, three pairs of genital setae (*g a*, *g m*, *g p*). Subhumeral unusually situated toward dorsum.

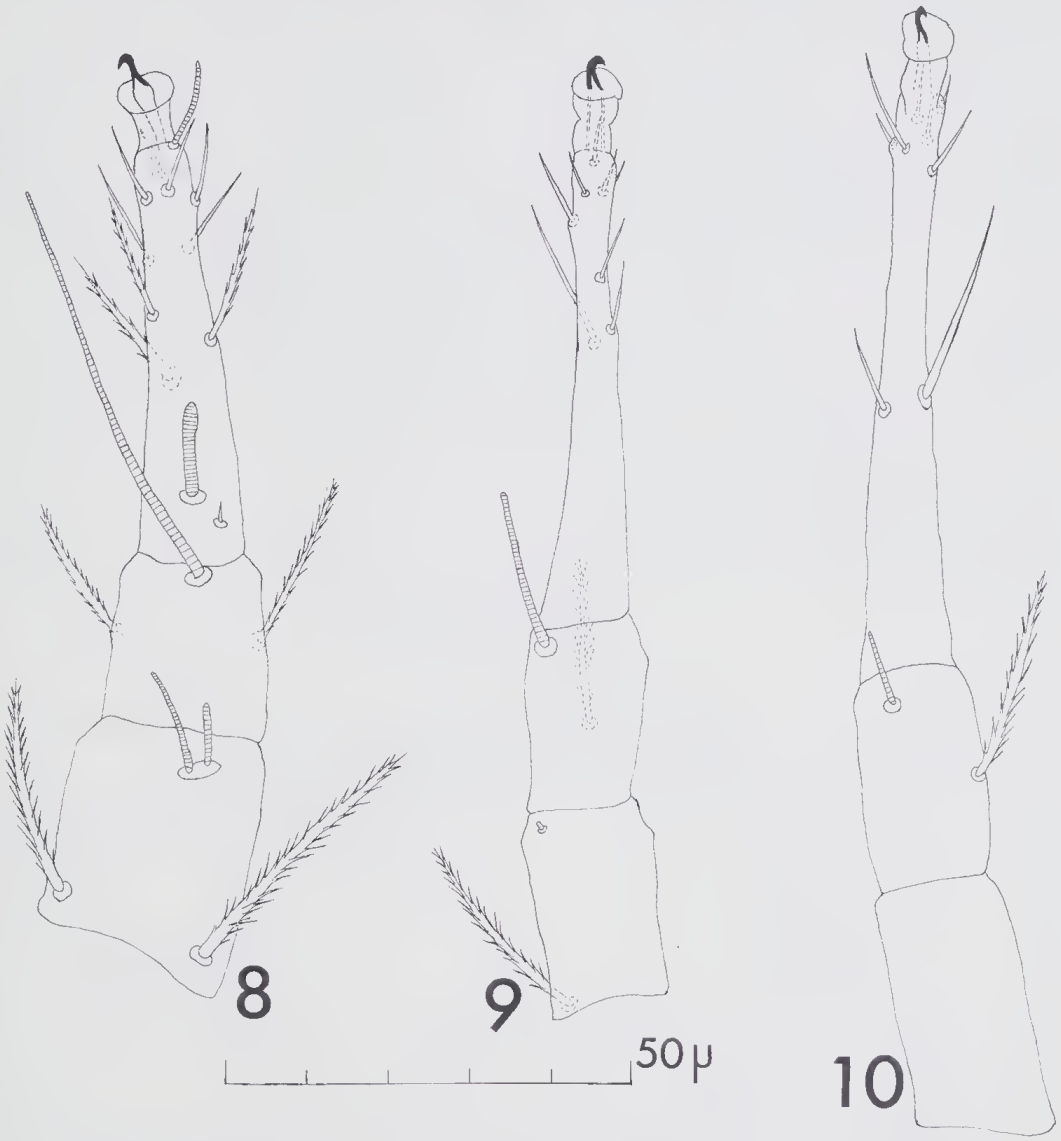
Dorsum (Fig. 7): Cuticle almost soft with numerous very small cuticular elevations with rounded top. Sclerotized shields or crista and sejugal furrow absent. All dorsal setae *Glycyphagus*-like densely pectinated and long, with exception of *d 2*, *d 3*, *h* and *l 2*, which are remarkably short. Supracoxal seta thick and densely pectinated, Grandjean organ with biiid hairy end. Small dorsal glands near laterals 2.

Legs (Figs 8-10) with long tarsi, stalked pretarsi and small empodial claws of subequal shape. Chaetotaxy of legs: tarsi 9-9-8-8, tibiae 2-2-1-1,



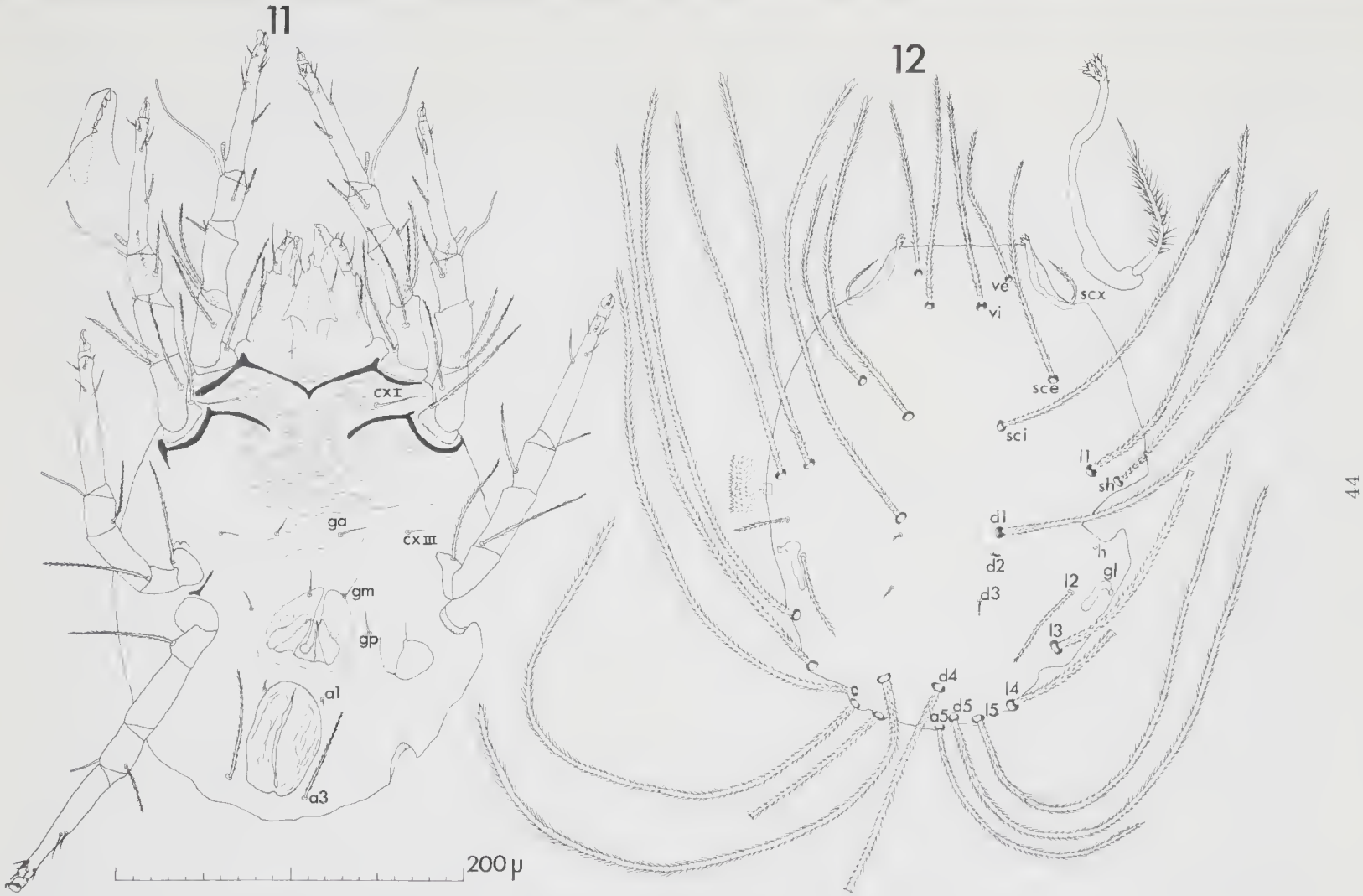
Figs 6-7: *Marsupiopus zyzomys* sp. nov., tritonymph venter (6) and dorsum (7).

genua 2-2-1-0, femora 1-1-0-1, trochanters 1-1-1-0. Solenidiotaxy: tarsi 2-1-0-0, tibiae 1-1-1-1, genua 2-1-1-0. Famulus present. Leg setae mostly pectinated, no specialized setae present. Measurements in Table 2.



Figs 8-10: *Marsupiopus zyzomys* sp. nov., tritonymph, legs I (8), III (9) and IV (10).

Male (Fig. 11) of white to pale yellow colour, with soft cuticle, carrying numerous small cuticular elevations with rounded top. These cuticular formations are different from free-living *Glycyphagus* species and adults of 'phoretic' species living during hypopial stage on mammals, like *Glycyphagus*



Figs 11-12: *Marsupiopus zyzomys* sp. nov., male venter (11) and dorsum (12).

(Myacarus) hypudaei (Koch, 1841), *Marsupialichus marsupialis* Fain et al. 1972, *Zibethacarus ondatrae* (Rupes & Whitaker, 1968), *Lophioglyphus liciosus* Volgin, 1941 (= *Apodemopus apodemi* Fain, 1965), *Baloghella melis* Mahunka, 1963 (= *Melesodectes auricularis* Fain & Lukoschus, 1968), *Dermacarus sciurinus* Koch, 1841. Epimera I fused in V-shape, II-IV free and faintly developed. Genital region between legs IV with 20 μ short penis, genital apodemes and two pairs of small genital suckers. Anal region ventral subterminal with 60 μ long anal split and three pairs of anal setae. Gnathosoma like in tritonymph with dentated chelicerae. In coxal regions I and II beside cuticular elevations many transverse striations of weave-like appearance. Cuticle in genital region smooth. Length 345 μ, width 215 μ.

Dorsum (**Fig. 12**) generally as in tritonymph, without sclerotized shields or crista and without sejugal furrow. All dorsal setae longer and stronger pectinated than in tritonymph with exception of dorsal 2 and 3, which are considerably thinner and shorter. Grandjean organ with trifid end.

Legs (**Figs 13-16**) with long tarsi of subequal length, stalked pretarsi and empodial claws. Pretarsi in hind legs larger than in forelegs. Chaetotaxy and solenidiotaxy like in tritonymph, no specialized setae present. Measurements in **Table 2.**

Table 2: Measurements (in μ) in stages of *Marsupiopus zyzomys* sp. nov.

	male			female			tritonymph		
cx I, cx III	29		12	34		21	22		16
g a, g m, g p	14	15	14	16	5	18	12	7	14
v i, v e	130		96	103		77	75		56
sc i, sc e	204		130	163		98	122		53
dorsal 1, 2, 3	283	6	10	190	5	10	154	9	19
4, 5	359		356	283		277	208		197
lateral 1, 2, 3	231	53	324	163	34	230	133	26	172
4, 5	324		350	257		235	163		144
scx, h, sh	32	31	214	29	26	164	28	16	97
tarsus I-IV	74, 76, 80, 78			79, 81, 80, 93			48, 48, 56, 61		
phi I-IV	73, 41, 26, 16			64, 46, 23, 14			53, 34, 13, 8		
ϱmega 1, 3, II	13	11	10	10	10	10	9	8	10
anal 1, 2, 3	5	-	60	5	6	41	6	-	29
4, 5, 6	-	167	-	20	126	47	-	63	-

Figs 13-16: *Marsupiopus zyzomys* sp. nov., male legs I-IV.

Female (Fig. 17): Fairly sclerotized specimen, pressed out of tritonymph during mounting, similar to tritonymph and male. Length 350 μ, width 209 μ. Large genital region between legs III and IV with two 80 μ long valves, two pairs of small (8 μ) genital suckers and little epigynium (*eg*), not connected to epimera. Anus terminally with six pairs of anal setae. Coxals, genitals and two pairs of anals setiform, all other idiosomatal setae long and pectinate, somewhat shorter than in male. Copulatory tube 22 μ long dorsally in front of anal split. Legs like in male. Measurements in Table 2.

Host and Localities

Zyzomys argurus (Thomas, 1889) from the following places of Kimberley region: Napier Downs, 30 August-3 September 1976 (field numbers 2640, 2641, 2643, 2644, 2647, 2653, 2662), Mount Hart, 11-13 September (2690, 2693, 2701 host of type), Beverley Springs, 18-22 September (2726, 2731, 2734, 2737, 2738, 2792, 2794), Brooking Springs, 28 September 1976

(2810, 2813, 2814), Mitchell Plateau, 19-29 October 1976 (Western Australian Museum registration numbers M15538, M15594, M15609). All hosts trapped by mammal group of Western Australia Field Programme. Mitchell Plateau specimens were identified by D. Kitchener, Western Australian Museum, Perth; specimens from other listed localities were identified by L.E. Keller, Field Museum of Natural History, Chicago.

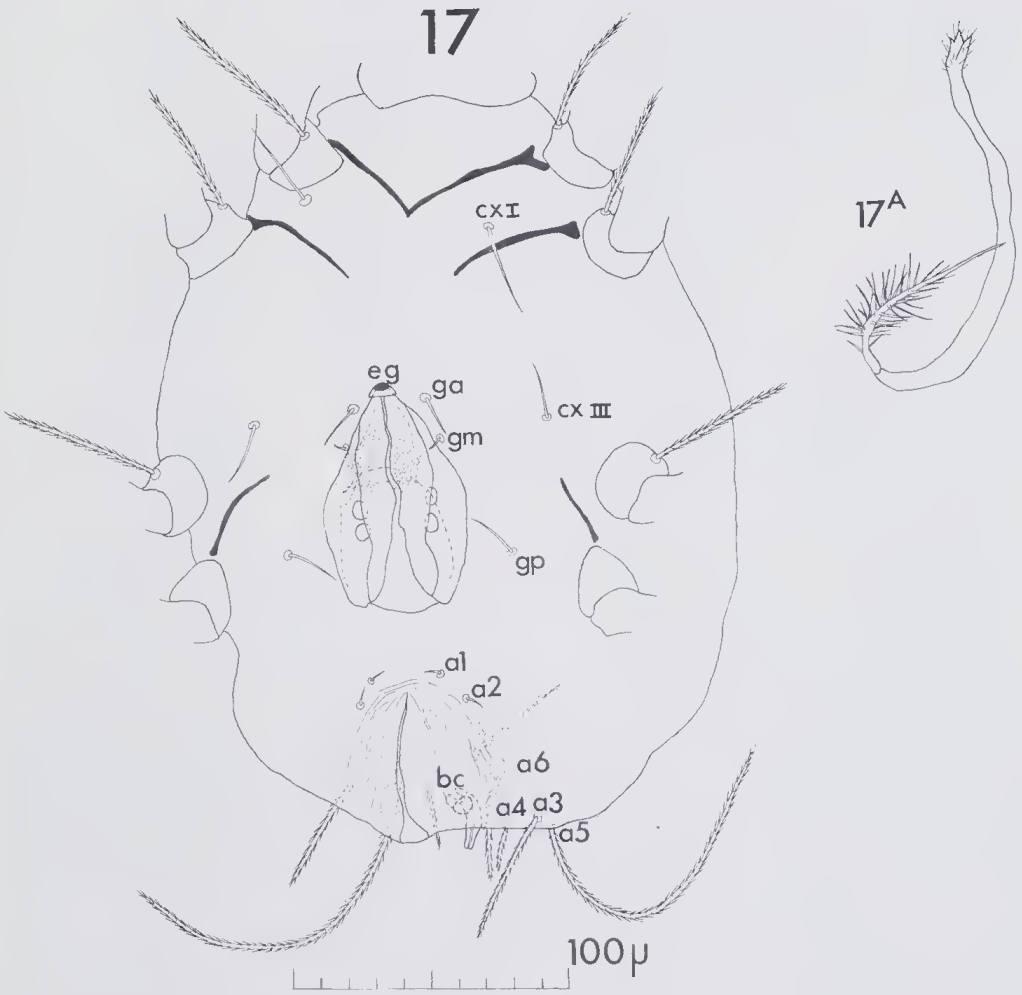


Fig. 17: *Marsupiopus zyzomys* sp. nov., female venter.

Fig. 17A: *Marsupiopus zyzomys* sp. nov., supra coxal seta and grandjean's organ.

Pathology

Hypopi live in hair follicles of tail; they have not yet been found in other places on hosts. Infected follicles are often marked by larger amounts of hyperceratosis between tail scales and by dark ring around follicle opening.

Fig. 18: Tails of *Zyzomys argurus* (a) young specimen with thin tail, (b) subadult with starting fat deposition in tail, (c) subadult with partial loss of tail skin, (d) adult with amputated tail.

Fig. 19: Histological section of tail skin of *Zyzomys argurus* infected by *Marsupiopus zyzomys* hypopus. (For meaning of symbols see text.)

Histological sections (Fig. 19) show part of epidermis (*Ep*) of tail with hyperceratosis (*hc*) of infected hair follicle in comparison with non-infected follicle around hair (*H*). Wall of follicle indicates the degenerative characteristics (*deg*) of extra-intestinal digestion, known from feeding places of chiggers and ticks. Hypopi do not possess mouth parts and mouth opening and feeding is not yet studied. Sebaceous glands (*s.gl*) are strongly swollen in infected parts and connective tissues show disarrangements and degeneration. Part of the hairs of infected follicles are lost.

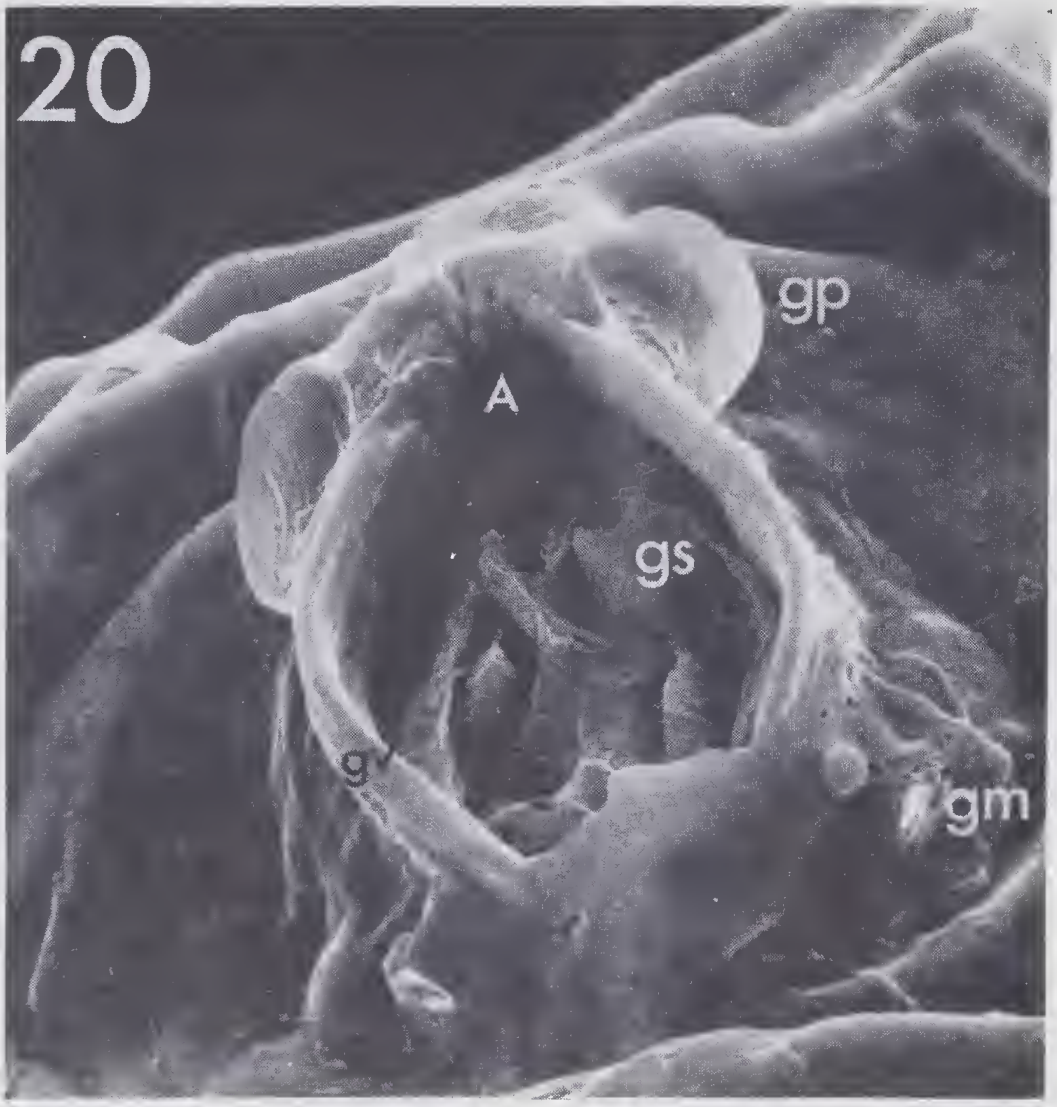


Fig. 20: Scanning picture of genital region of *Marsupiopus zyzomys* hypopus showing genital suckers and anal opening. (For meaning of symbols see text.)

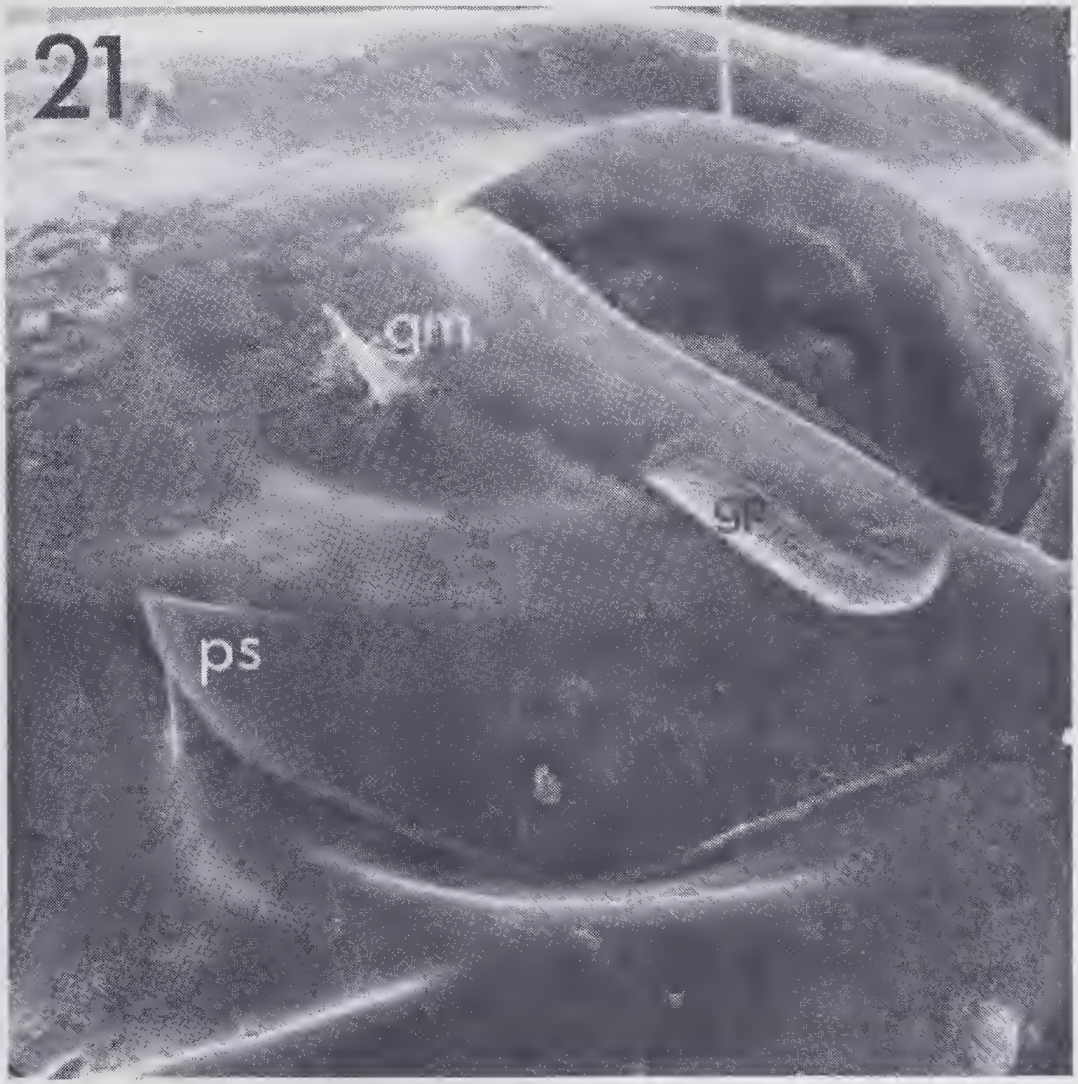


Fig. 21: Scanning picture of genital region of *Marsupiopus zyzomys* hypopus showing perigenital sclerite with lateral spur (*ps*) and adhesive disc-like genital posterior seta (*gp*). (For meaning of symbols see text.)

Rock-rats of genus *Zyzomys* are known to have very fragile tails. Walker (1964) stated, 'Many of the specimens have lost part of their tails, which would indicate that the terminal section is brittle and breaks easily.' Ride (1970), based on field experiences, could give more details: 'Although other rats and mice lose their tails with ease if they are maltreated, the hair and flesh strip from the vertebrae of rock-rats particularly easily; the animal soon amputates the remaining naked skeleton to leave a shortened stump'. Our investigations show clearly that degeneration of tail tissues, caused by the

hypopi, results in loss of tail skin. Thus, we may not regard these hypopi as phoretic, using the host for transportation to habitats favourable for further development and reproduction, as suggested in the title of the monograph by Fain (1969). They are real temporary parasites with distinct pathological action. Fig. 18, obtained by courtesy of D. Kitchener, Perth, compares thin tail of young rat (a), older subadult rat with still entire tail (b), young rat with partly lost skin (c) and adult rat with thick tail stump (d).

LIFE CYCLE

Investigations of more than 100 hosts and morphological characteristics of age allow some remarks on biology and life cycle of mites. Adults of these rock-rats are easily recognized, because they have thick tails rather like those of some species of Australian marsupials and representatives of different mammal orders in deserts in various parts of the world. Juveniles are thin-tailed.

Hypopi were found in larger numbers in thin-tailed females only, few in thin-tailed males; they are absent in thick-tailed adult rats. After being pressed out of follicles and stimulated by cold-shock, hypopi develop within three days to tritonymphs and in a further four days to adults, if humidity and temperature are suitable.

Compared with studied life cycles of *Lophioglyphys liciosus* Lukoschus *et al.*, 1972 (= *Apodemopus apodemi* Fain, 1965), *Marsupialichus marsupialis* Fain *et al.*, 1972 and *Baloghella melis* Lukoschus *et al.*, 1971 (= *Melesodectes auricularis* Fain & Lukoschus, 1968), we may suggest that during reproduction period of hosts hypopi leave the follicles and develop quickly within the host's nest. Free hypopi enter follicles of nestlings and remain there until gravidity. They do not enter follicles of old mice. In nature, stimulation for further development of hypopi is probably given by hormonal changes in host during gravidity and lactation. Environmental factors during dry period in Kimberley region restrict surviving possibilities to hypopial stage, which is protected by body temperature and humidity of surrounding tissues of host. Although we did not succeed in rearing larvae, protonymphs, and free hypopi, we suggest a life cycle with a very long hypopial stage during the dry season, and a shorter period of free living stages in the nests of hosts during the wet season used for reproduction and infection of the next host generation. The well-developed chelicerae indicate that adults feed normally on organic debris in the nests. Presence of adults and homoiomorph developmental stages only during a short period in the

wet season in the hidden nests of hosts may explain why the free living stages of the subfamily have not yet been found and described.

Systematic Position of the Genus *Marsupiopus* Fain, 1968

The genus *Marsupiopus* Fain, 1968 has been described from hypopial forms. According to the characters of the adult specimens obtained from the rearing of hypopi, it appears that this genus belongs to the family Glycyphagidae. This genus is distinguished from all the known genera in the Glycyphagidae by the following characteristics:

1 Cuticular ornamentation consisting of very small elevations with rounded apices.
2 Shape of supracoxal seta, which is thick, densely barbed and not branched.
3 Grandjean's organ with bifid hairy end.
4 Small length of tarsi, especially the anterior tarsi.
5 Absence of ω *2*.
6 The very small development of the setae *d 2* and *d 3*.

Some of these characteristics, especially the small length of the tarsi, distinguish this genus from all the other genera in the Glycyphagidae. We think, therefore, that the subfamily Marsupiopinae Fain, 1968, which had been created to accommodate the genus *Marsupiopus*, should provisionally be retained until more material becomes available for comparative study.

Deposition of Types

Holotype and figured specimens in Western Australian Museum, Perth. Paratypes (hypopi and tritonymphs) in: Perth; Field Museum of Natural History, Chicago; U.S. National Museum of Natural History, Washington, D.C.; The Acarology Laboratory, Columbus, Ohio; British Museum (Natural History), London; Muséum National d'Histoire Naturelle, Paris; Institute of Parasitology, Prague; Zoologisches Museum, Hamburg; Forschungsinstitut Senckenberg, Frankfurt; B.P. Bishop Museum, Honolulu; Institut de Médecine Tropicale Prince Léopold, Antwerp; Zoölogisch Laboratorium, Nijmegen.

MARSUPIOPUS ANTECHINUS FAIN & LUKOSCHUS, 1976

The species has been described from *Antechinus flavipes* from Wandanian and from a host of unknown locality.

From an alcohol preserved *Sminthopsis granulipes* Troughton, 1932, Lake Grace, W.A., 10 March 1973, K. Youngson, WAM coll. no. M10205, hypopi

have been collected from hair follicles of tail, which fit in most characteristics and measurements to description. There are some small differences: the second thin setae on tibiae I and II are only 8 μ long, while they are 14 μ in specimens from typical host; claws of legs I and II are longer (12 μ) than in typical series (9); scapular setae are arranged on transverse rank; perigenital ring is smaller (54 wide, 42 long) than in typical series (60, 54).

Although we know that small morphological differences in hypopi from different host species and widely separated geographical regions may be of systematical importance and hypopi may give rise to very different adults like in *Lophioglyphus liciosus* Volgin, 1964 and *L. japonensis* Lukoschus *et al.*, 1977, we will not separate them until adults are known from both host species.

Deposition of specimens as in previous species.

MARSUPIOPUS LEPORILLI PSEUDOMYS FAIN & LUKOSCHUS, 1976

Subspecies has been collected from *Pseudomys hermannsburgensis* (Waite, 1896) from Hermannsburg and *Rattus fuscipes* (Waterhouse, 1839) from unknown locality.

From *Sminthopsis murina* (Waterhouse, 1838), Beacon, W.A., 29 August 1975, collected by K. Youngson, host in WAM coll. no. M12607, hypopi have been collected from tail hair follicles, which fit the characteristics and measurements of typical series with exception of longer *v i* 16 μ (13 μ in typical series) and shorter 17 μ solenidion *phi* II (23 μ in typical series).

Deposition of specimens as in *M. zyzomys.*

ACKNOWLEDGEMENTS

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